



ABTS 2020

STEM²D STUDENT ACTIVITIES

SEPTEMBER 30, 2020



NATIONAL INSTITUTE FOR
WORK & LEARNING



ABOUT STEM²D

“STEM” or Science, Technology, Engineering, and Mathematics, refers to an increasingly important sector of studies and careers. In 2015, Johnson & Johnson added ²D to its women in STEM initiative (WiSTEM²D) to recognize and elevate the manufacturing and design disciplines, which are directly aligned with the other STEM subjects.

WiSTEM²D addresses gender disparities within STEM²D fields and engages young girls and women through four pillars:

- **Youth Programs**
- University Programs
- Professional Programs
- Partnership Programs

SPARKING ENCHANTMENT WITH STEM²D SUBJECTS FOR YOUNG WOMEN AND GIRLS THROUGH CREATIVE PROBLEM SOLVING AND PLAY

- JOHNSON & JOHNSON YOUTH PILLAR
PROGRAMS

STEM²D Activities

A suite of activities for educators, parents, and volunteers to use as they engage youth with STEM²D. They incorporate a comprehensive approach to student-centered learning.

- Interactive, hands-on, minds on learning
- Collaboration & teamwork
- Inquiry-based investigations
- Project based with real-life application
- Build confidence for student
- Exposure to diverse role models

Activity Listing

- Student Activities
- Ignite!
- Activities at Home
- STEM²D Quiz



Activities at Home

Ignite activities typically take 5 to 15 minutes to complete and use everyday materials that you can find at home. They're also excellent ways to learn STEM²D skills outside of school. Whether you want something exciting to do on the weekend or you're looking for another fun way to learn when school is canceled, *ignite activities* are for you!

Each activity, video, and tip sheet is available in Chinese, English, French, German, Indonesian, Italian, Portuguese, and Spanish. Simply click the links below the videos.

Up with Gas



Elephant Toothpaste



STEM²D

How do you want to make a difference?
Choose your top three priorities.

By helping people

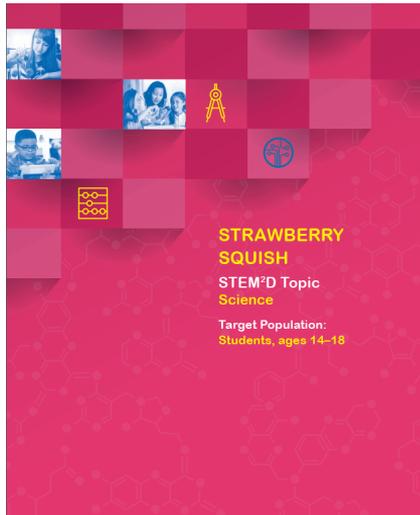
By helping the planet

By helping animals

QUIZ

Student STEM²D Activities

- A series of fun, interactive hands-on activities in the STEM²D subjects for elementary and secondary school students. (25 and counting)
 - Include educator and student materials with extended learning activities.
 - The activity guide has structured time, questions and tips to engage students, skills addressed, and a list of careers related to the activity.



STRAWBERRY SQUISH
STEM²D Topic
Science

Target Population:
Students, ages 14–18

The poster features a red and white checkered background with various icons: a microscope, a person, a DNA helix, a person with a magnifying glass, a person with a test tube, and a person with a microscope.

ACTIVITY DESCRIPTION

In this team-based, hands-on activity, students will extract DNA from smashed strawberries and learn how DNA and genes play an important role in human development.



ESTIMATED TIME

This session typically takes **60 minutes** to complete and should be conducted in one session.

STUDENT DISCOVERIES

Students will:

- Participate in a team-based learning experience.
- Build important STEM²D skills, such as collaboration, investigation, teamwork, and testing.
- Realize that STEM²D offers diverse and exciting career opportunities.
- Have fun experiencing STEM²D.

GETTING READY

Materials:

- Computer with projector
- PowerPoint: Strawberry Squish
- Pre-Activity Checklist
- Tell My Story Form
- Hand wipes or paper towels (for clean-up)
- Cooler with ice or a refrigerator
- Pen/pencil, 1 per student
- Tablecloths (number will depend on tables being used)



STEM²D Skills

- Collaboration
- Communication
- Critical Thinking
- Decision Making
- Investigative and Laboratory Skills
- Problem Solving
- Scientific Inquiry
- Teamwork

Tips for Facilitators on STEM²D Careers

Share with students that there are many different kinds of careers related to STEM²D. Some STEM²D careers related to this activity are:

- Anthropologist/ Archeologist
- Biochemist
- Biological Scientist
- Biophysicist
- Forensic Scientist
- Geneticist
- Immunologist
- Plant Breeder
- Pharmacologist
- Science Laboratory Technician

TIPS FOR WORKING WITH STUDENTS

Encourage students to ask questions to gain deeper understanding.

- Ask open-ended questions to encourage student reflection and discussion. For example:
 - What do you see in the plastic bag?
 - What other fruits do you think we could do this with?
 - What other characteristics do you see based on human genes?
- Remind students to perform the step you have modeled during the group challenge.
- Encourage all students to participate in the challenge.
- Move around the learning space and provide support when necessary.

Activities Inventory

<i>Activity Name</i>	<i>Description</i>	<i>Target Age</i>	<i>STEM²D Focus</i>	<i>Length (mins)</i>
<i>A Day In the Life of a Person with Diabetes</i>	Measure the “blood-glucose levels” of a person with diabetes and explore how diet, exercise, medication, and new technologies may affect those levels.	12-16	S, M	210
Backpack Challenge	Students will design a new backpack that they can use.	12-16	D	90
<i>Biomimicry in Design and Engineering</i>	Students learn how nature and the living world provide inspiration for addressing the world’s challenges. They will design a structure or product inspired by nature.	14-18	D, E	60
<i>Build a Scientific Research Vessel</i>	Design and build a seaworthy vessel that floats in water and can hold a specific amount of weight.	14-18	E, D	60
Building a Medical Device	Students design, build, and test a medical device that meets a customer’s needs.	12-18	E, D	150
<i>Building a Prosthetic Arm</i>	Design, build, and test a prosthetic arm that meets a customer’s needs.	9-13	M, D	180
Building with Wonderful Junk	In this construction activity, young people have fun as they work in teams to plan and build large structures using recyclable materials brought from home.	11-14	D, E, S, M	60
<i>Change It, Create It, Solve It, Engineer It</i>	Students practice engineering design. They begin to recognize that technologies and new innovations result when engineers apply science and math principles to design and develop products, structures, machines, tools, or systems that improve everyday life.	11-14	E, T, D	45-60
<i>Cleanser Challenge</i>	Students explore science by creating their own facial products that meet specific consumer needs.	11-14	S, D	90
Cotton Ball Catapult	In this team-based, hands-on activity, students learn about the product development process by designing and testing a cotton ball catapult.	14-18	D, E	60
<i>Create It, Try It, Manufacture It</i>	Students identify the importance of personal experiences to making career choices and recognize opportunities in manufacturing for people with STEM ² D skills and training.	11-14	M	45-60
Egg Drop Challenge	Students explore design and manufacturing concepts by designing, building, testing, improving, and executing a device to protect an egg from breaking when dropped from a minimum height.	12-16	D, M	90
Exploring Research & Development	Students will take on the role of a biomedical scientist and conduct laboratory research to examine the impact of different drug formulations	11-14	S, M	60
<i>From Innovation to the Patient: The Pharmaceutical R&D Process</i>	This activity introduces students to pharmaceutical research and development—the process of developing new medicines that improve and save patients’ lives.	11-14	S	60
<i>Great Bones</i>	Students learn about research and development (R&D) and how engineers use this process to design different technologies and medical devices to help doctors successfully treat patients.	12-16	D, E	60
Ouch! Need a Band-Aid: Designing, Constructing, and Packaging as BAND-AID	In this engineering design activity, young students have fun working in teams to construct and package an adhesive bandage for a specific injury using everyday materials provided for them.	7-10	D, E, S, M, M	90
Pollution Solution	Learn how pollution affects the environment and brainstorm solutions to pollution in the world.	12-14	S	60
<i>Putting Wind Energy to Work</i>	Students learn how wind is used to generate energy and will learn about the design process by designing a wind turbine.	10-15	D	140
Soapy Mathematics	Students will apply basic mathematics principles and skills to analyze the performance and determine corrective actions, if needed, of a production line.	14-18	M, E, M	60-90
<i>Strawberry Squish</i>	Extract DNA from smashed strawberries and learn how DNA and genes play an important role in human development.	14-18	S	60
<i>Technology Everywhere</i>	Use circuits to make an alarm. Students will learn about switches and use this new information and the engineering design process to complete a challenge.	11-14	T, E	45-60
<i>The Design Challenge</i>	Students learn about human-centered design principles and complete a design challenge around oral hygiene.	11-14	D, E, T	270
<i>The Supply Chain and Lean Manufacturing</i>	Students learn about the manufacturing process, use their critical thinking and problem-solving skills to evaluate a supply chain, and apply “lean principles” to make it work more efficiently.	11-14	M	75
What’s the Code? Coding Robot Movements using Sound	In this coding design activity, young students have fun working in teams to design and execute a code for specific robot movements using everyday materials provided for them.	7-10	D, E, S, M	60
Where Does the Water Go? Calculating a Neighborhood Water Footprint	Students calculate the water usage of households in an imaginary neighborhood. They determine if there is enough water to meet demand or if restrictions need to be put in place. Students design and build a pumping station to move water from the reservoir to their house.	10-14	D, E, S, M	60

Educators/Volunteers Resources

- **SPARK WiSTEM²D!** (Available in the 6 UN Languages)
 - Strategies to Spark Interest
 - STEM²D careers by academic degree level
 - Volunteer Tips
- **Volunteer Tips!** (Available in the 6 UN Languages)
 - Engaging with Girls
 - Engaging with Youth
 - Intro to Gender
 - STEM²D Messaging for Parents
 - Youth Brain Development
- **e-Modules (10-15 mins)**
 - How to Encourage and Engage Girls in their Academic Attainment.
 - Creating a Positive STEM²D Identity
 - The Importance of Role Models in Career Exploration
 - Being Student Centered



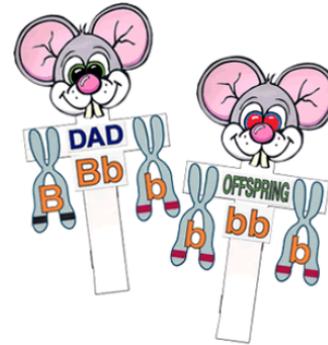
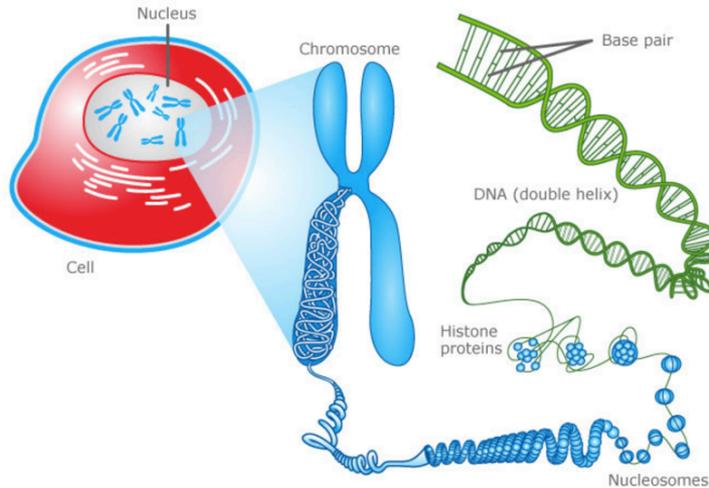
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Strawberry Squish Activity

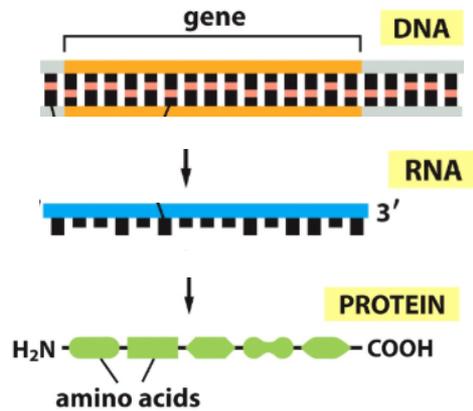
Deoxyribonucleic Acid (DNA)

- DNA is the hereditary material in humans and almost all other organisms
- DNA is a double strand of polynucleotide chains.
- DNA contains instructions for development, survival, and reproduction
- DNA is found in the cell nucleus and mitochondria of the cell.
- Nearly every cell in a person's body has the same DNA



DNA's FATE = Protein Synthesis

- DNA sequences must be converted into messages that can be used to produce proteins
- Proteins are the complex molecules that do most of the work in our bodies



EXAMPLE PROTEINS

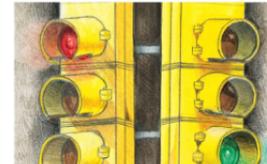
PHOTORECEPTORS - EYES



ENZYMES –DIGESTIVE TRACK

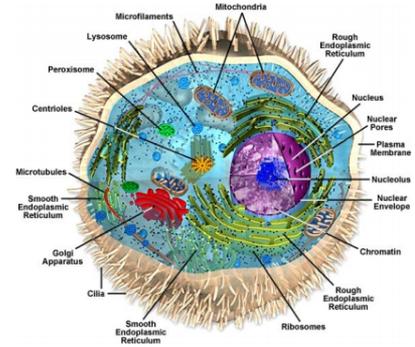


SIGNAL PROTEINS – CELL GROWTH



Visualizing DNA: Human vs. Strawberry

- Most human cells contain 46 chromosomes in 23 pairs.
 - Diploid: 2 copies of each chromosome per cell, one set each per parent.
 - Karyotype profile when DNA is doubling in size.
 - Need a lot of cells to study changes in DNA/gene expressions.
- Strawberries can have between 14 and 56 chromosomes.
 - 7 different types of unique chromosomes.
 - Two (2) to eight (8) copies of each type of chromosome per cell
 - Octoploid (8): 56 is the most common across the world.



Strawberry Squish Instructions



Materials

- ¼ tsp of NaCl (salt)
- 45mL of H₂O
- 5mL Dish Soap
- 5mL Isopropyl or rubbing alcohol
- 1 Strawberry
- Bowl/Cup
- Mixing Stick
- Filter/Cheese Cloth/Suture
- 50 mL Tube
- Ziploc Bag (sandwich)

- Step 1:** Add ¼ tsp of NaCl (salt) to the bowl/cup.
- Step 2:** Measure and add 45mL H₂O & to the bowl/cup.
- Step 3:** Add 5mL dish of soap and mix. (Extraction Mixture)
- Step 4:** Place the strawberry in the Ziploc bag.
- Step 5:** Pour the “Extraction Mixture” into the Ziploc bag with the strawberry.
- Step 6:** Remove the air from the bag and mash the fruit with your fingers.
- Step 7:** Place filter over the cup and pour the fruit pulp mixture.
- Step 8:** Transfer 35mL of the filtered liquid into the 50mL tube.
- Step 9:** Get 5mL of isopropyl alcohol from cooler. Slowly transfer it into your 50mL test tube. *Do not mix/shake! Gently squirt the IPA down the side of the test tube.*
- Step 10:** Look through the top layer (35-40 mL zone) of the tube to see a white “stringy, gel-like” material. This is DNA!!